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METHOD AND SYSTEM FOR STOPPING ELEVATORS

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Method and System for Stopping Elevators

[0001] The invention concerns a method and a system for stopping elevators using AC-motors driven by static frequency converters.

[0002] The stopping of drives for elevators is technically relevant from a safety point of view. When considering the functional course of elevators, the stopping after activation of a safety device and the unintentional starting during loading or unloading, respectively, are particularly essential.

[0003] In order to take these demands into account, the current supply to the motor is realised by means of two monitored relays or one monitored relay and one monitored control device, which interrupts the power supply by means of static components. This ensures that in the operation states mentioned above the motor can create no torque and the brake is engaged.

[0004] To this, DIN EN 81-1, point 12.7, states as follows:

[0005] The stopping of the elevator on activation of an electrical safety device must take place as follows:

[0006] In motors, which are supplied directly by the AC or DC mains, the power supply must be interrupted by two mutually independent relays, whose switching elements are connected in series in the motor current circuit.

[0007] If the main switching element of one of the relays has not opened when the elevator has stopped, a renewed starting must be prevented before the next direction change.

[0008] With a drive according to the Ward-Leonard system and generating the activation by classical means, two mutually independent relays must interrupt either:

a. the rotor circuit

b. the energising circuit of the generator

c. one relay interrupts the rotor circuit and the other interrupts the energising circuit of the generator.

[0009] When the main armature of one of the two relays does not open when the elevator stops, a renewed starting must be prevented before the next direction change.

[0010] With a supply and control of AC or DC motors with static means, the power supply to the motor must be interrupted by two mutually independent relays. When the main armature of one of the two relays does not open when the elevator stands still, a renewed starting must be prevented before the next direction change.

[0011] Alternatively, a circuit comprising:

1. a relay, which interrupts the power supply on all poles. The coil of the relay must be turned off at least before each change of operation direction. When the relay does not open, a renewed starting of the elevator must be prevented
2. a control device that interrupts the power supply in the static elements
3. a monitoring device that tests if the power supply is interrupted at each stop of the elevator

must be provided.

[0012] During the trade fair SPS//PC/DRIVES 2002 a new system from the company Control Techniques, the Unidrive SP, was presented, which is intended to be an automation platform provide a number of new, innovative solutions for the elevator business. A related article on the subject in the magazine LIFT-REPORT, 29th volume (2003), No. 4, page 80, ends with the statement: "A TÜV

approval according to EN 81-1 is in progress. This will permit saving one motor relay."

[0013] This outlined state of the art makes it clear that experts consider the motor protection principle as indispensable. This is in spite of the fact that state of the art involves substantial disadvantages.

[0014] Particularly with elevators without machine room, the space requirements and the noise generation of the relays to be used are disturbing. The high switching cycle prevents the use of a switching relay at the input of the frequency converter. Thus, it is difficult to locate the frequency converter directly at the motor. The costs of the relays, their mounting and wiring increase the manufacturing costs.

[0015] From an EMV point of view, the switching of the frequency converter outlet and thus the interruption of the screening is bad. It is also known that switching off the converter outlet at low motor frequencies generates higher contact erosion, which again causes a shorter life of the relays.

[0016] It is the task of the invention to eliminate these disadvantages and completely abandon the principle of using motor relays.

[0017] This task is solved with the features of the method claim 1 and the system claim 4. Advantageous embodiments are covered by the subclaims.

[0018] According to the invention, the stopping of the drive is achieved by means of a switching structure, which on the one hand safely disconnects the control signals creating the rotating field, that is, removing a driving torque of the motor, and on the other hand causes the activation of the brake belonging to the drive.

[0019] Thus, the condition is utilised that AC motors can only generate a driving torque, when a rotating field is available at the winding.

[0020] When supplying AC motors through static frequency converters, the rotating field is generated by modulation of a direct voltage. This modulation usually occurs through 6 power semiconductors connected to the direct voltage and a logic unit, which emits the control impulses required for the modulation.

[0021] The safety system stopping the elevator works on the basis of a brake relay according to EN 954-1, category 4, integrated in the converter or on the basis of two monitored relays, which cause the actuation of the brake and at the same time act upon a safety switch according to EN 81-1. Thus, the safety switch interrupts the control impulses required for the modulation of the direct voltage. This prevents the generation of a rotating field creating motor torque.

[0022] With this invention, the frequency converter can be used for elevators without having relays at its outlet.

[0023] Thus, the converter can be located close to the drive or in the motor connection box of the drive. This enables integrated driving solutions for elevators with little mounting effort. The disturbing switching noises of the relays are avoided. The elevator control can be made substantially more compact, as the relays are no longer required and the converter can be located at the motor. The screening of the motor cables is not interrupted by the relays, or, in the case that the converter is located in the motor housing, is no longer required.

[0024] The replacement of the relay contacts because of erosion is avoided. This facilitates the maintenance. The costs of the relays and their wiring are avoided.

[0025] The switch according to the invention will be explained by means of the drawing.

[0026] The safety circuit 1 of the elevator is usually made as series-connected safety systems 2, which act upon the brake relay 6 integrated in the frequency converter 18 via the elevator control 3.

[0027] The brake relay 6 is a relay according to EN 954-1, category 4, or can be realised by means of two monitored relays. By means of the contacts 19, the brake relay 6 controls the brake 15 of the motor 14 and acts upon the safety switch via contact 10. The safety switch preferably conforms to EN 81-1.

[0028] In order to reduce the contact wear, the power semiconductor 20 is connected in series with the contact 19 of the brake relay 6. Due to the faster switching behaviour of the power semiconductor 20, an erosion of the contact 19 is avoided.

[0029] The logic unit 8 of the frequency converter 18 provides the pulse pattern to the power semiconductors located in the inverter forming the torque. The safety switch 9 blocks the pulse pattern, when the contacts 10 of the brake relay are open.

[0030] The power part of the frequency converter 18 comprises a rectifier 11 rectifying the mains voltage, a direct voltage intermediate circuit 12 and an inverter 13, which is preferably made of six power semiconductors. A defined switching of the power semiconductors will generate a three-phase alternating voltage with variable basic wave amplitude and frequency.

[0031] When the elevator control 3 receives a call 5, and the safety system 2 is closed, the brake relay will be activated. Via the monitoring device 4, the elevator control 3 monitors the function of the brake relay 6.

[0032] By actuating the brake relay 6, the driving signals 7, such as driving direction and speed, will be transmitted to the frequency converter 18 from the elevator control.

[0033] In accordance with the driving signals, the frequency converter logic 8 generates a pulse pattern generating a rotating field for the power semiconductor.

[0034] As soon as the brake relay 6 is pulled in, the pulse patterns are switched from the safety switch 9 to the power semiconductors. Thus, based on the intermediate circuit voltage the power semiconductors can generate a rotating field with variable basic wave frequency through modulators.

[0035] When the brake relay is de-energised by an actuated safety system, on the one hand the brake is actuated and on the other hand the safety switch 9 is blocked. Thus, the rotating field of the motor 14 generating the torque is turned off, and the brake 15 retards the drive. This stops the drive.

[0036] The undesired starting of the drive is also avoided by this switching structure for as long as the brake relay is pulled in.

[0037] A defective power semiconductor in the inverter 13 causes disconnection or damaging of the power semiconductor in question. As the pulse pattern required for generating a rotating field is very complex, an incidental occurrence of a torque generating pulse pattern, for example caused by electromagnetic interference or component errors, can be prevented. In any case, the generation of a driving torque is avoided.

Reference number list

1. Elevator safety circuit
2. Safety systems
3. Elevator control
4. Monitoring device for the brake relay
5. Call
6. Brake relay
7. Driving signals
8. Frequency converter logic
9. Safety switch
10. Contacts of the brake relay
11. Rectifier
12. Direct voltage intermediate circuit
13. Inverter with power transistors
14. Motor
15. Brake
16. Magnetising current
17. Relay
18. Frequency converter
19. Brake control
20. Power semiconductor